

CARBON STORAGE IN PRAIRIE WETLANDS OF THE UNITED STATES AND IDEAS FOR FUTURE RESEARCH

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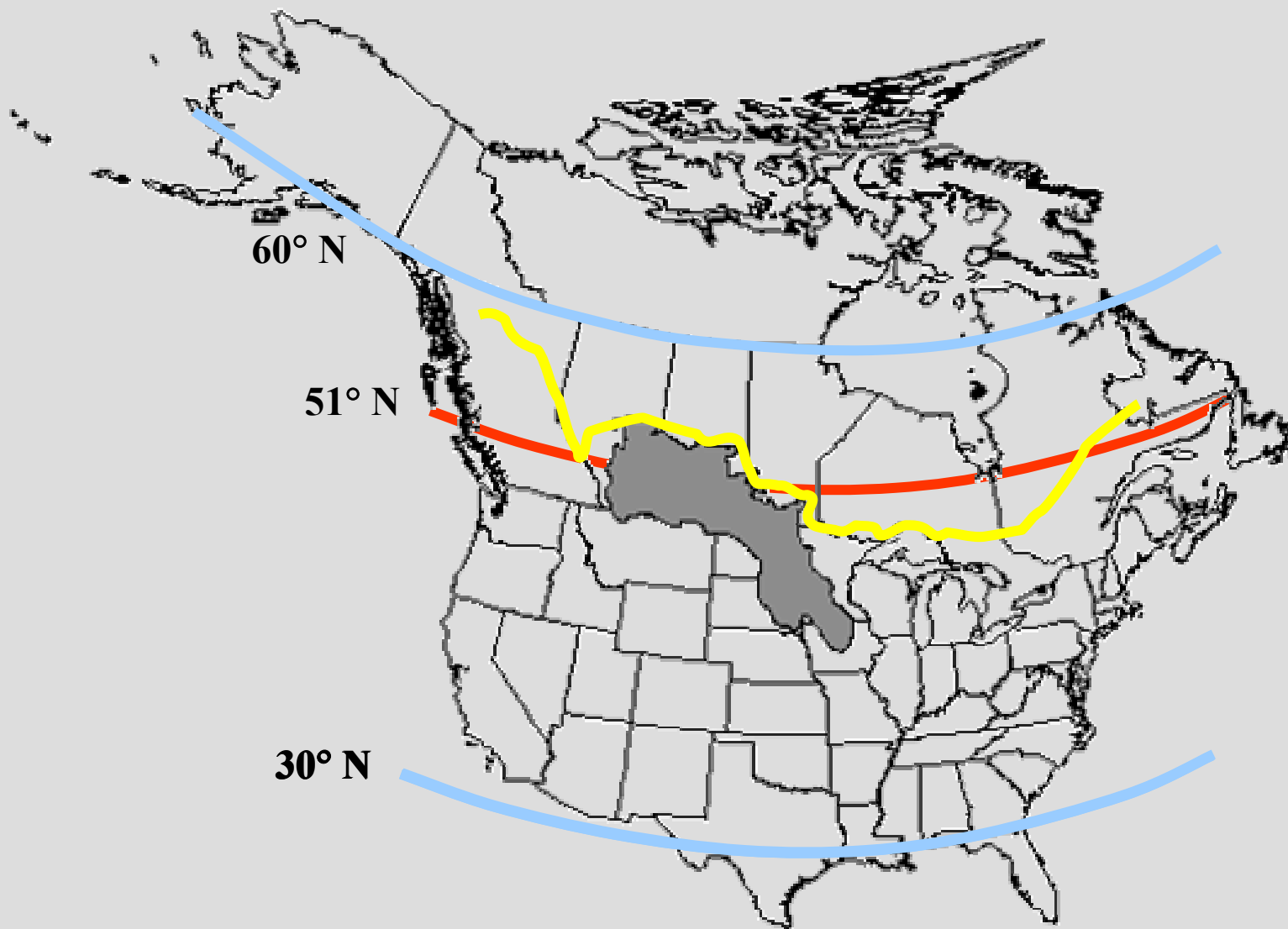
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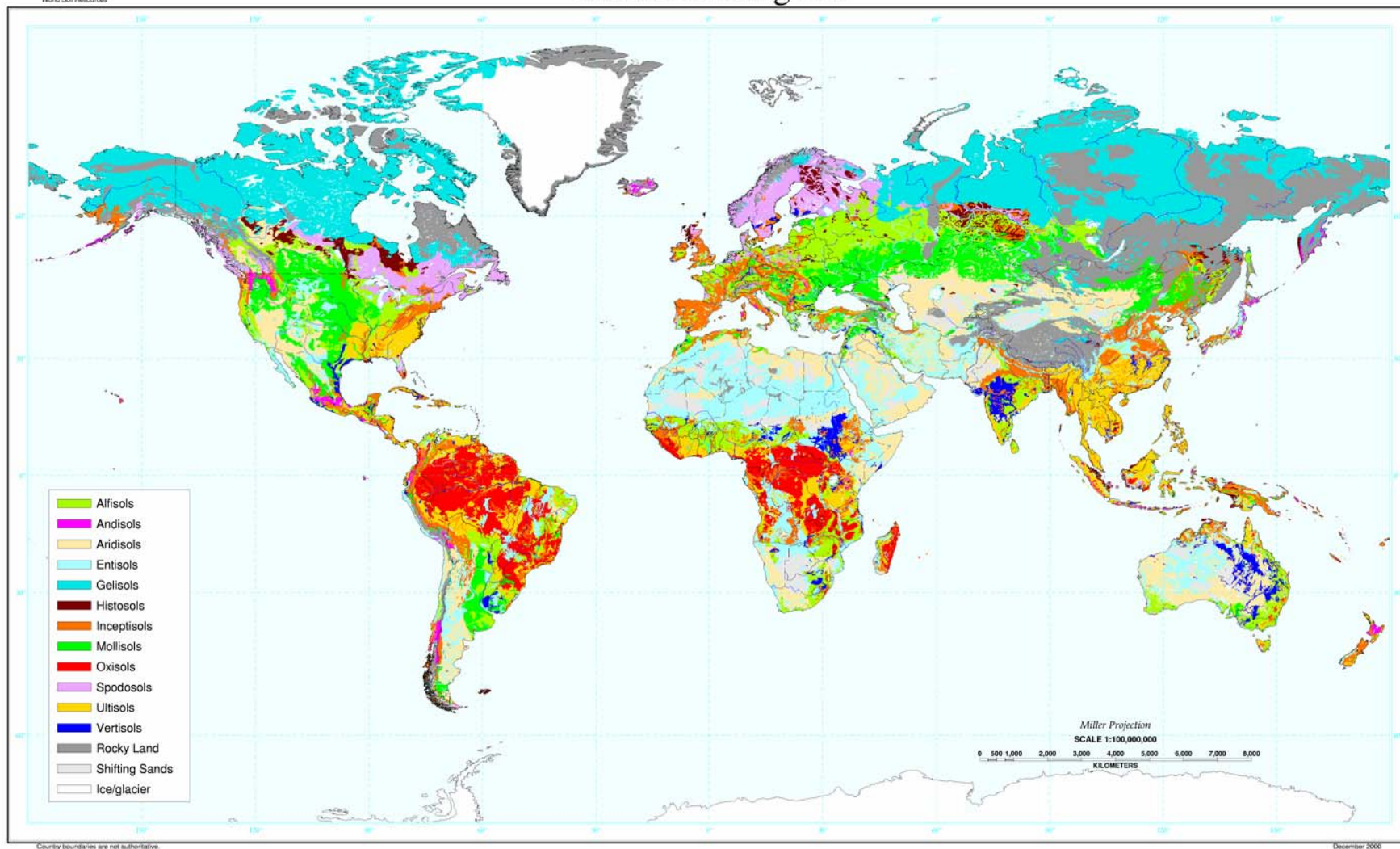
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Atmospheric Based Carbon Sink Studies

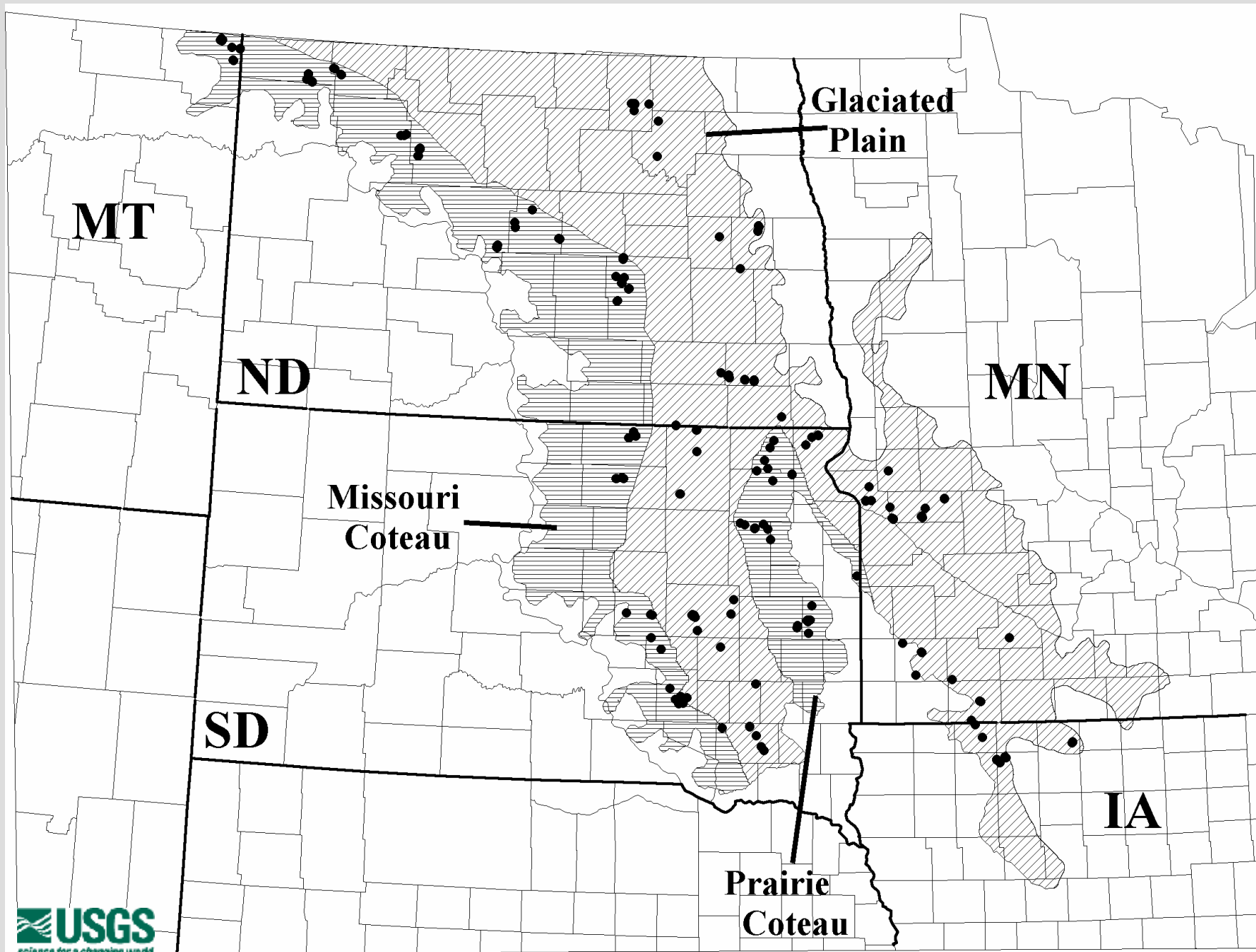
- **Large terrestrial carbon sink in the Northern Hemisphere (Tans et al. 1990, Ciais et al. 1995, and others)**
- **Sink is divided between North America and Eurasia (Schimel et al. 2001)**



Global Soil Regions



<http://www.nhq.nrcs.usda.gov/WSR/mapindx/order.htm>



Wetland Treatment Groups

- **Restored Wetlands**

Restored wetlands in CRP habitats or similar grasslands

- **Drained Wetlands**

Drained wetlands in CRP habitats or similar grasslands

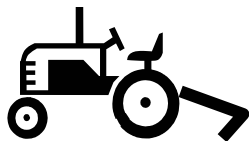
- **Nondrained Wetlands**

Nondrained wetlands in CRP habitats or similar grasslands

- **Reference Wetlands**

Nondrained wetlands with no history of tillage in their catchments

Prairie Wetland



0 – 15 cm

15 – 30 cm

30 – 60 cm

CO₂.

CO₂.

CO₂.

CO₂.

CO₂.

CO₂.

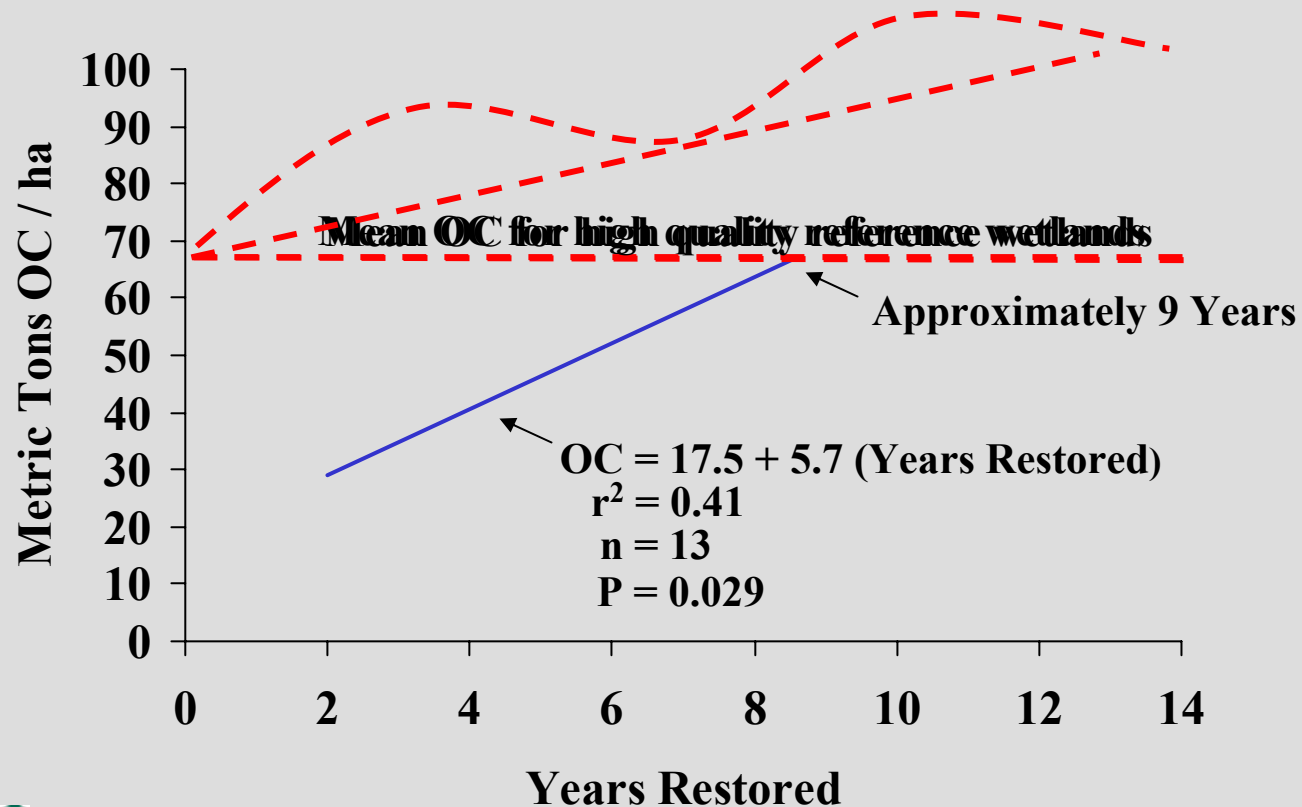
**Low Organic Carbon
Content**

**Medium Organic Carbon
Content**

**Low Organic Carbon
Content**

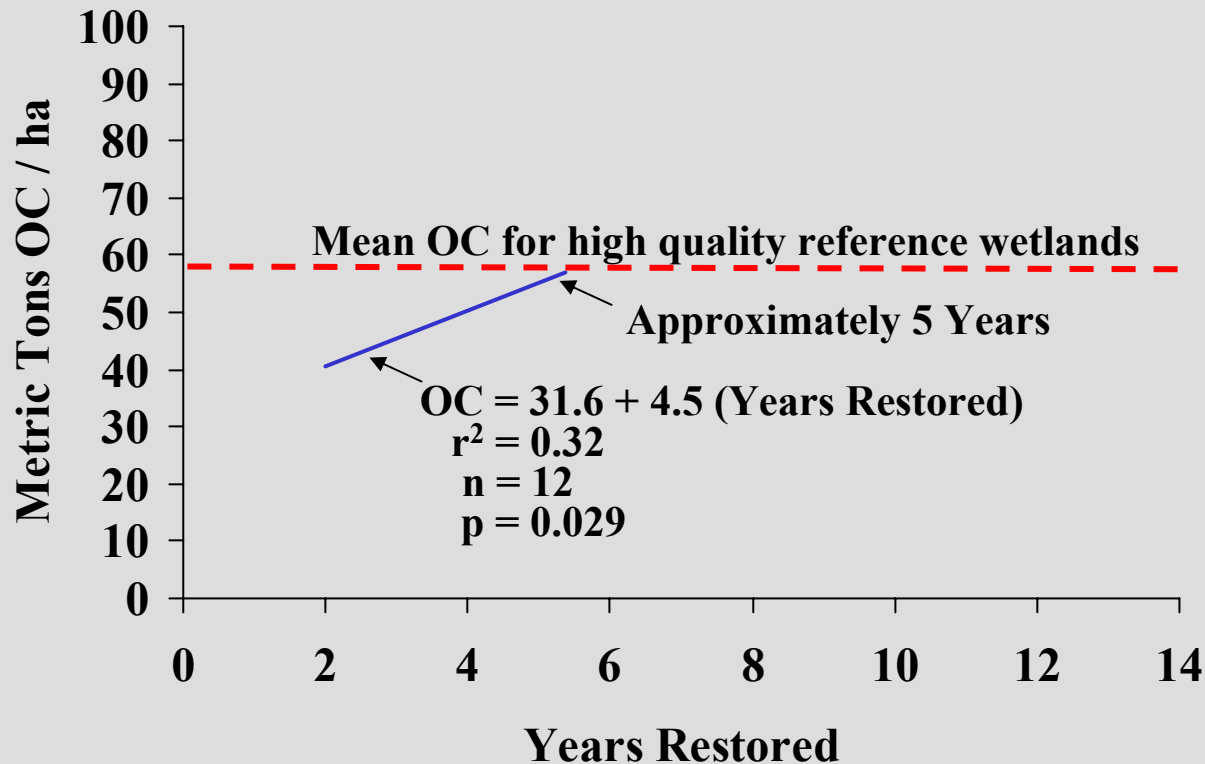
Rate of Organic Carbon Sequestration in Restored Semipermanent Wetlands in the Shallow Marsh (Surface 0-15 cm)

GLACIATED PLAINS



Rate of Organic Carbon Sequestration in Restored Semipermanent Wetlands in the Shallow Marsh (Surface 0-15 cm)

MISSOURI COTEAU

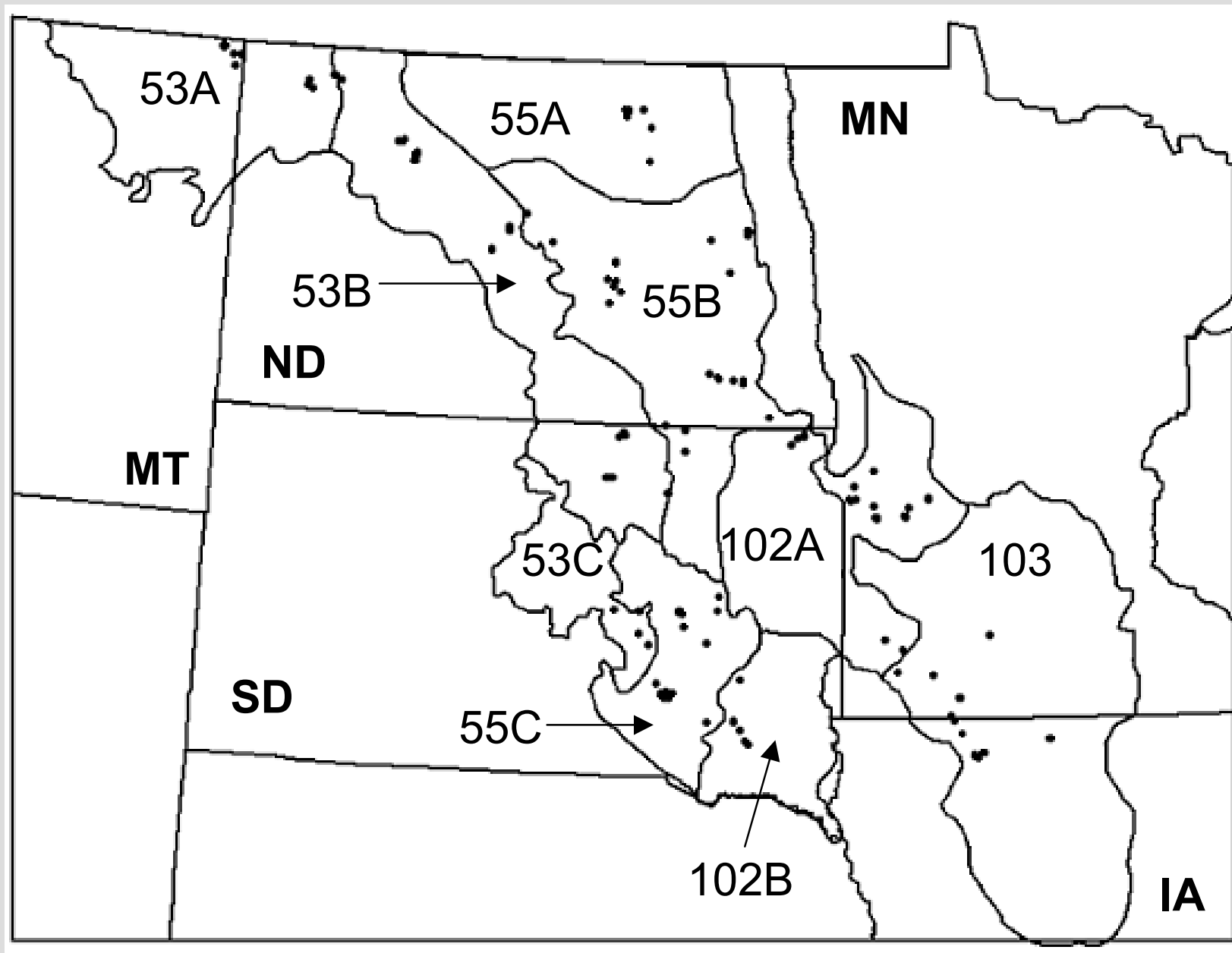


Overview of Carbon Studies

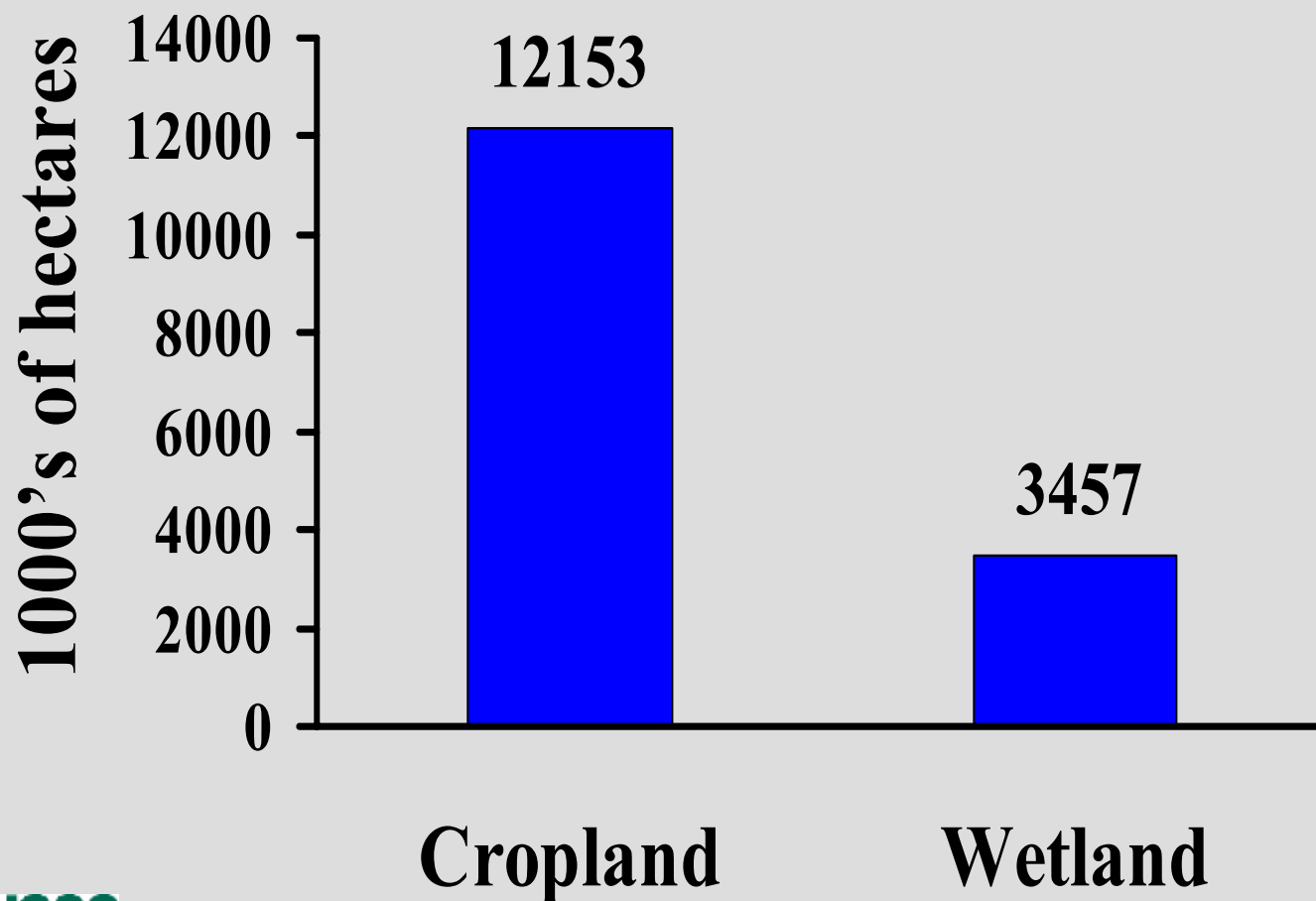
- **Farmed wetlands lost 6 to 26 metric tons OC ha⁻¹**
- **Restored wetlands recover lost carbon at rates up to 5 metric tons ha⁻¹ yr⁻¹**
- **Mass accumulation rate 0.83 metric tons OC ha⁻¹ yr⁻¹**
- **7-15 metric tons OC in standing crop (Wetzel 2001, McDougal 2001)**

Land Areas in Prairie Pothole Region

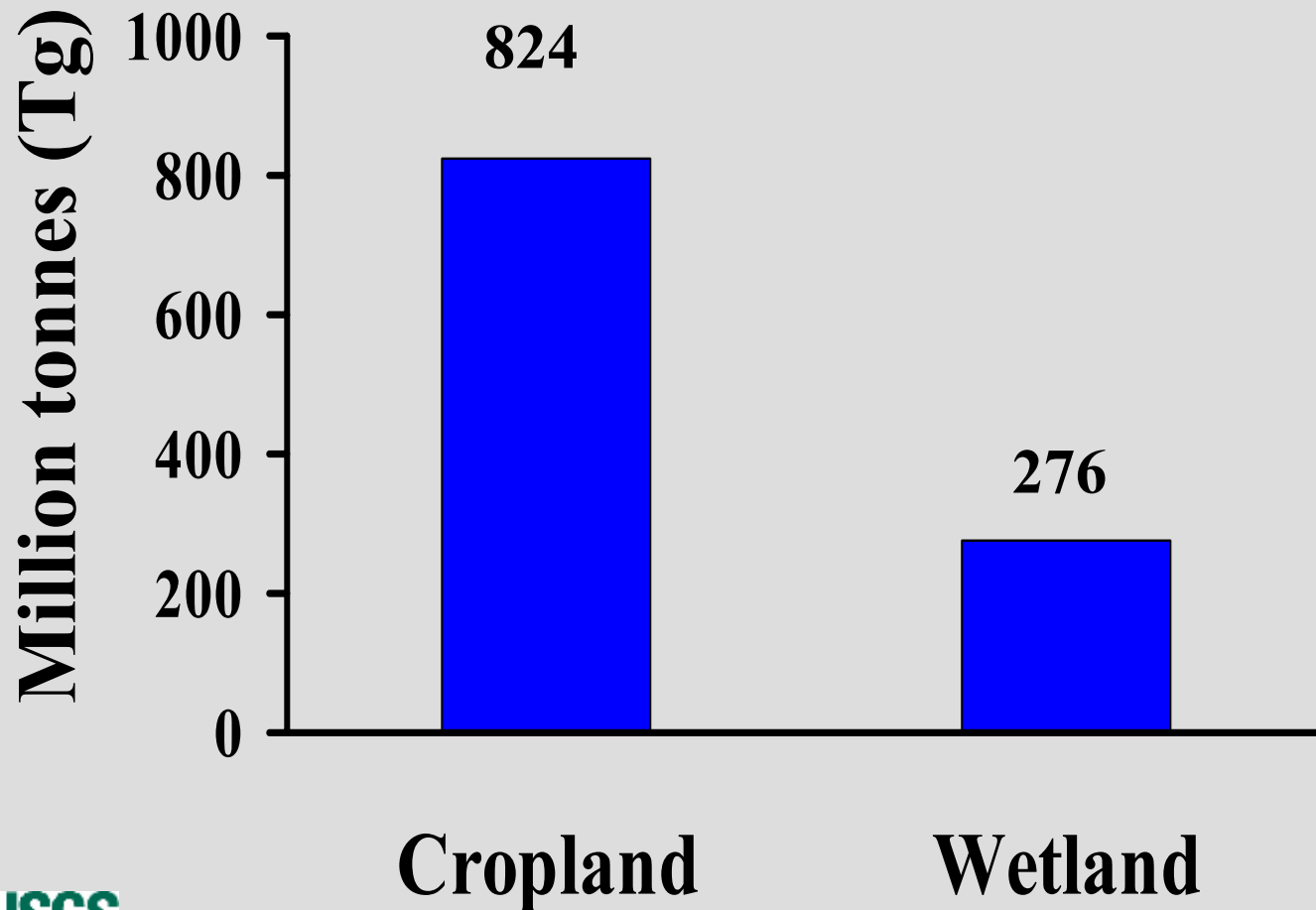
- U.S. wetland and upland areas estimated using 1992 USDA NRI data



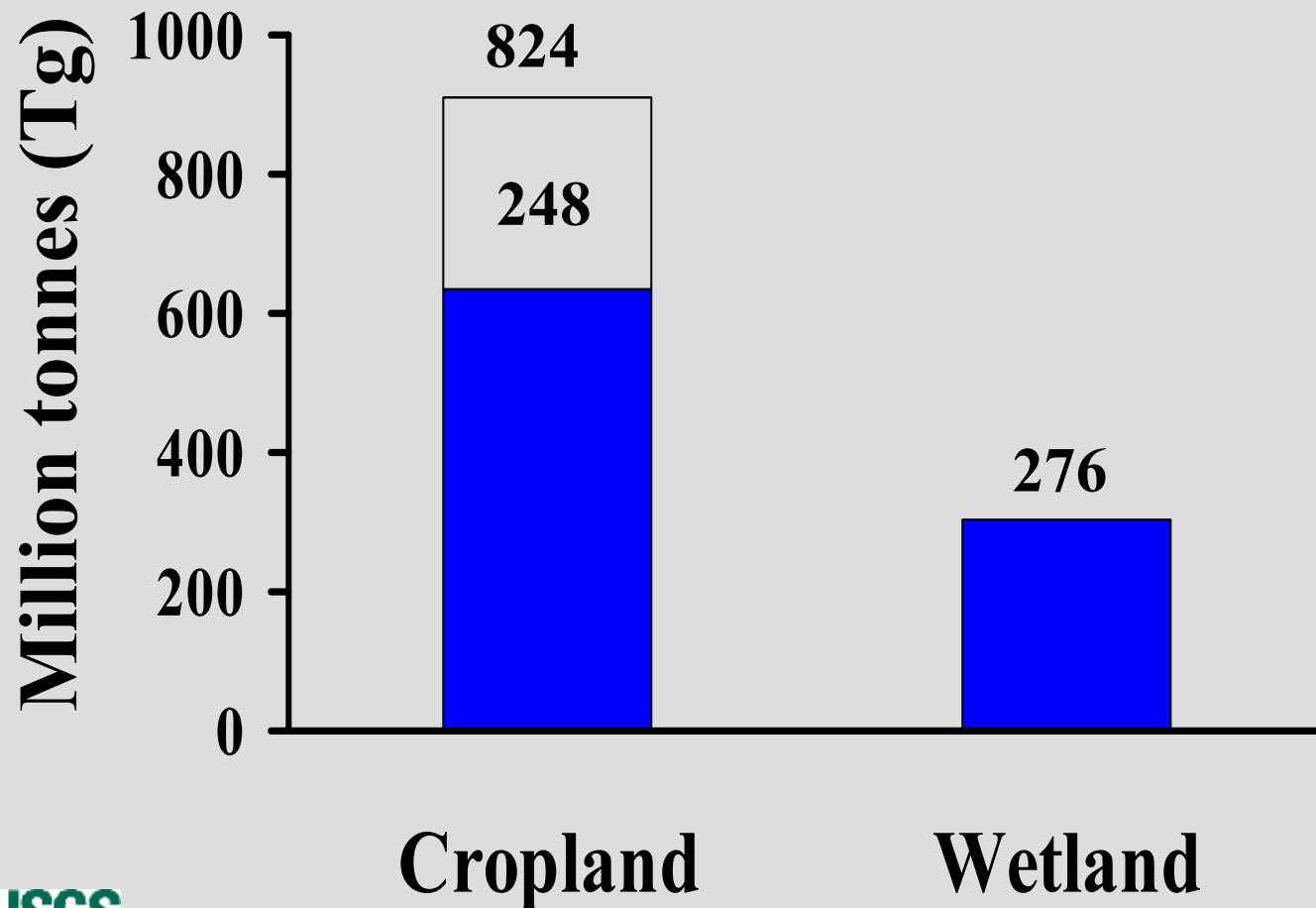
Area of Cropland and Wetlands in the Prairie Pothole Region of the USA



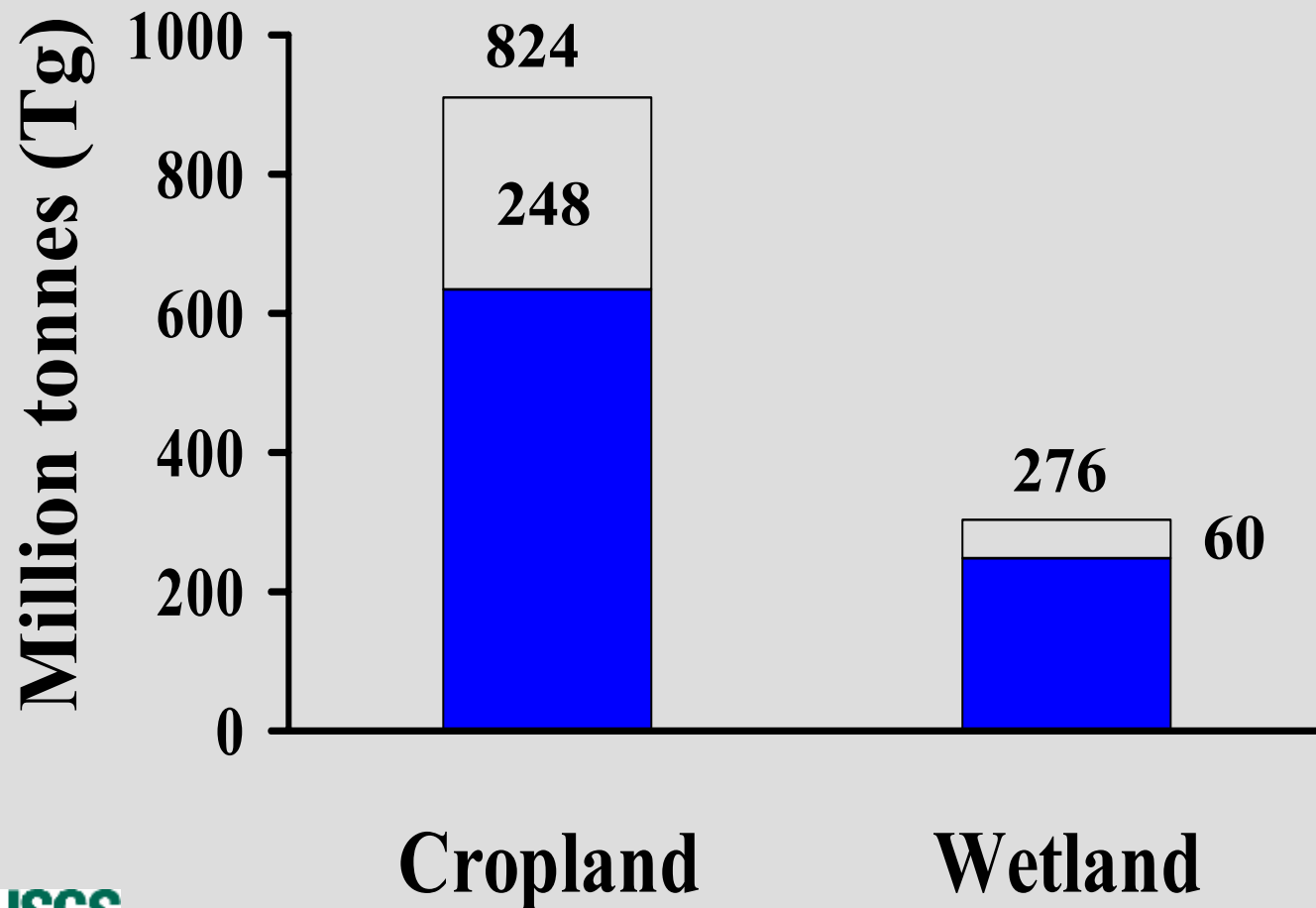
Organic Carbon Stores and Loss in the Prairie Pothole Region of the USA



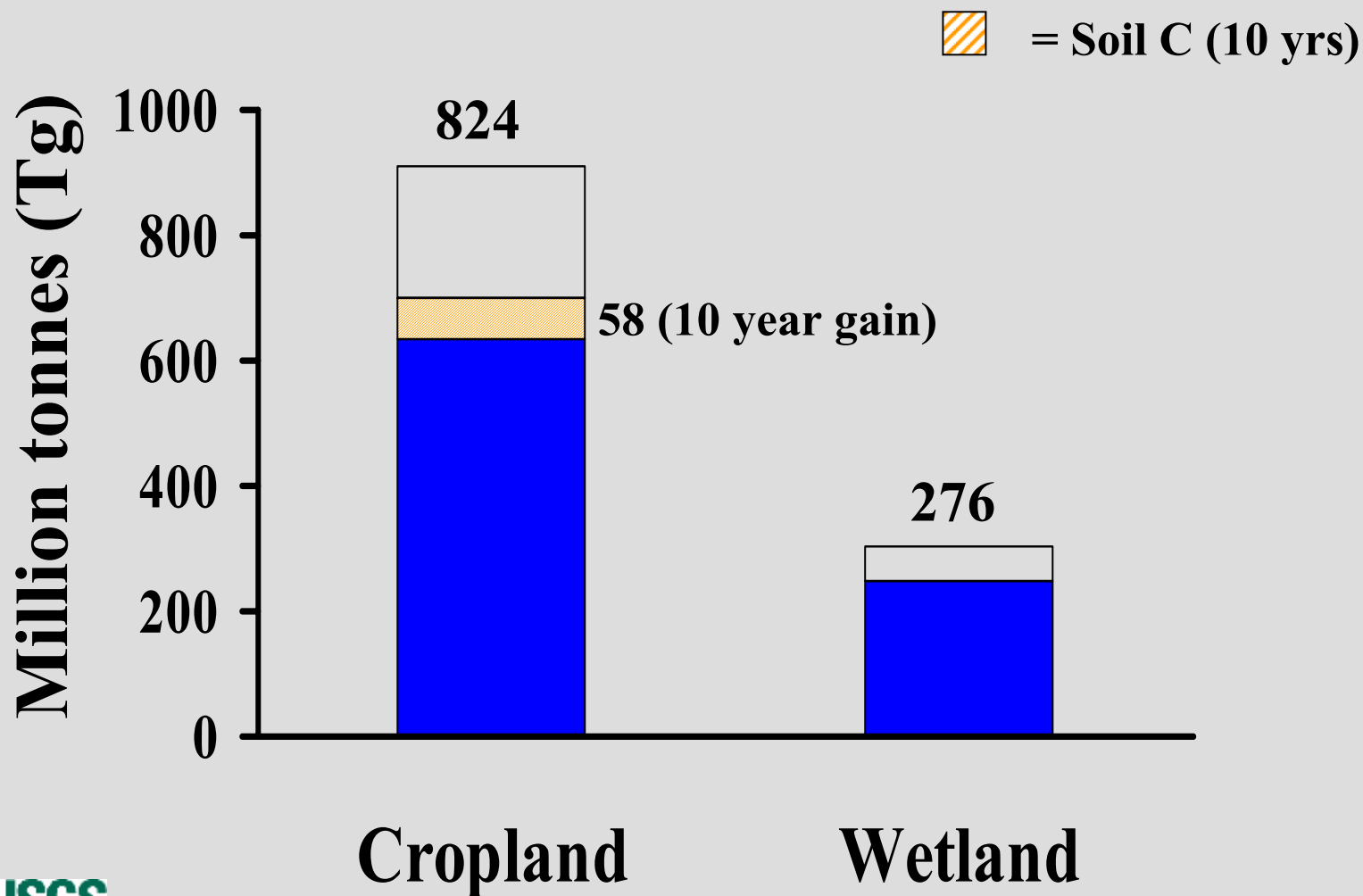
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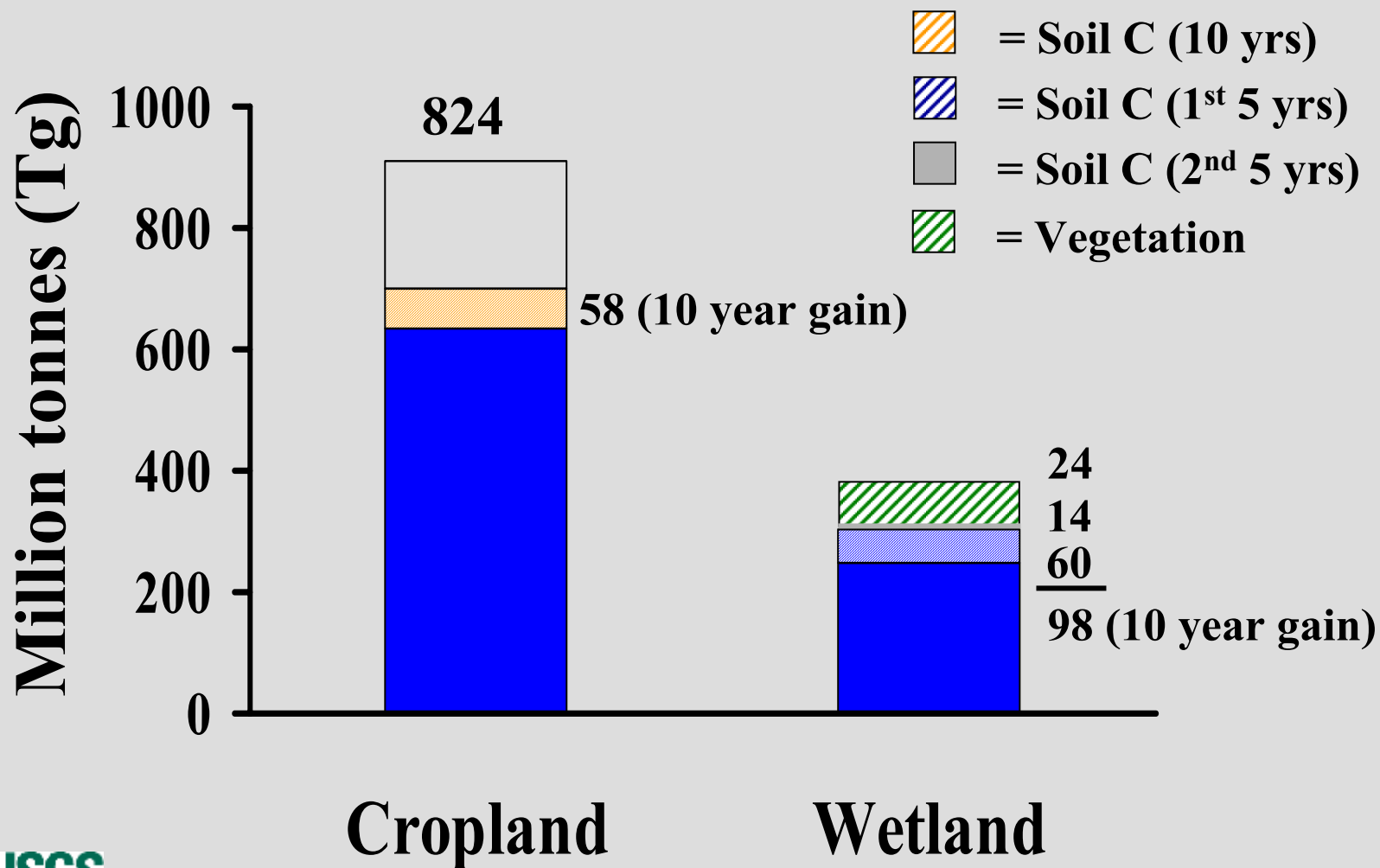
Organic Carbon Stores and Loss in the Prairie Pothole Region of the USA



Organic Carbon Stores and Loss in the Prairie Pothole Region of the USA



Organic Carbon Stores and Loss in the Prairie Pothole Region of the USA



Methane and Nitrous Oxide Emissions

- Requires quantification of Methane and Nitrous Oxide flux
- Methane 21 x CO₂
- Nitrous Oxide 310 x CO₂
- Both appear to be enhanced by agricultural amendments

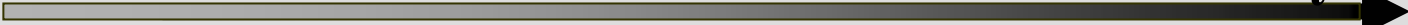
The Prairie Pothole Region of Northeastern Germany

- **Formed from Pleistocene glaciation
(10,000 – 12,000 years ago)**
- **Numerous wetlands formed from the
melting of ice blocks**
- **Wetland density of 0.6 to 40 km²**
- **Wetlands range in size from 0.01 to 5 ha**
- **80% of the wetlands are situated within
agriculture fields**

Influence of Agricultural Fertilizers on Nitrous Oxide and Methane Emission in Prairie Wetlands of Germany (Kalettka *et al.* 1998)

- **Eutrophic.** Farmed wetland with little topographic relief. Low to moderate input of inorganic nitrogen, ammonia, and other agricultural amendments.
- **Polytrophic.** Farmed wetland with much topographic relief. High input of inorganic nitrogen, ammonia, and other agricultural amendments.

Nitrous Oxide and Methane Emission from Enriched German Prairie Potholes. Data expressed as kg ha⁻¹ yr⁻¹



	Not Enriched		Heavily Enriched
	Nonfarmed	Eutrophic	Polytrophic
Nitrous Oxide	?	0.1	3.5
Methane	?	9.6	330

Recent Developments

- **Restored prairie wetlands were added to the National Carbon Sinks Table.**
- **Recent economic forecast would value restored prairie wetlands at \$45 acre⁻¹ year⁻¹ in 2005 and \$98 acre⁻¹ year⁻¹ in 2010.**

Research Needs

- **Quantify carbon storage and trace-gas flux**
- **Variation among wetland classes**
- **Quantify carbon storage associated with adjacent buffers and identify optimal buffer sizes**